ZXLD381

SINGLE OR MULTI CELL LED DRIVER SOLUTION

Summary

The ZXLD381 is a single cell LED driver designed for applications where step-up voltage conversion from a very low input voltage is required. These applications mainly operate from 1.5V or 1.2V cells. The IC generates constant current pulses that are ideal for driving single or multiple LEDs over a wide range of operating voltages.

The ZXLD381 uses a PFM control technique to drive an internal switching transistor which a low saturation resistance. This ensures high efficiency, even for input voltages as low as 1V.

The IC can start up under full load and operates down to an input voltage of only 0.9V.

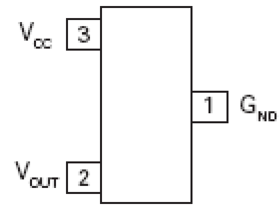
The ZXLD381 is offered in the space saving SOT23 package or in die form, offering an excellent cost vs performance solution for single cell LED driving applications.

Features

- 85% Efficiency
- User adjustable output current
- Single cell operation (0.9V minimum)
- Low saturation voltage switching transistor
- SOT23-3 package
- Available also in Die form
- Simple Application circuit

Pin Assignments

SOT23-3

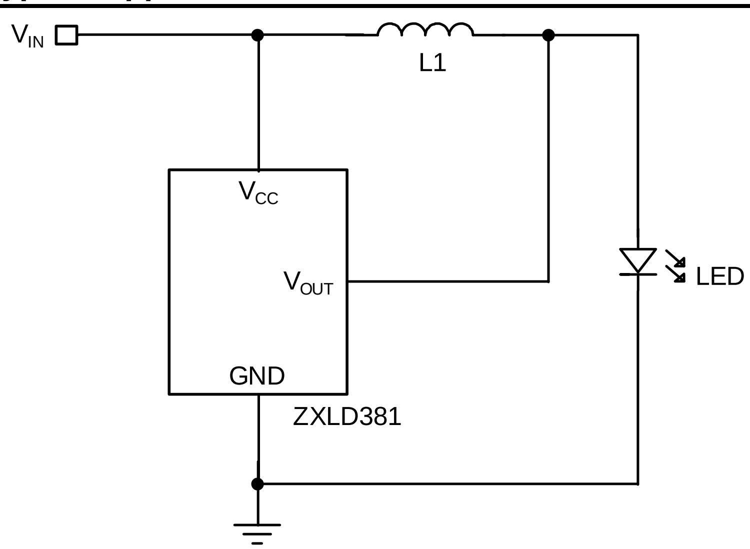


(Top View)

Application

- LED flashlights and torches
- LED backlights
- White LED driver

Typical Application Circuit



Block Diagram

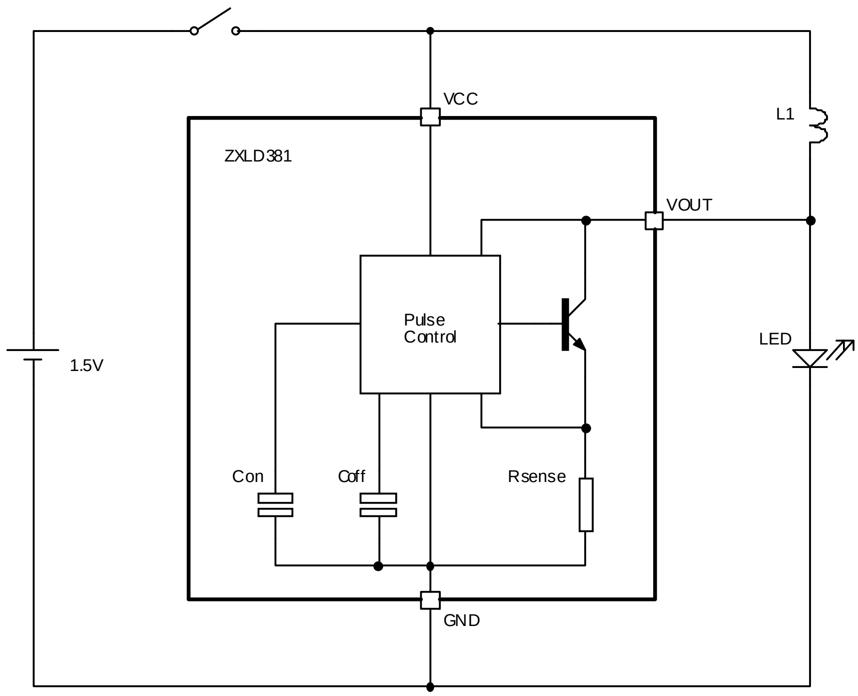


Fig 1. ZXLD381 Block Diagram

Pin Description

Pin No.	Name	Description
1	GND	Ground
2	V_{OUT}	Switch output external inductor/LED
3	V_{CC}	Supply voltage, generally Alkaline, NiMH or NiCd single cell

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage (V_{CC})	-0.6 to 10	V
Output Voltage (V_{OUT})	-0.6 to 20	V
Supply Current	20	mA
Output Switch Current	800	mA
Power Dissipation SOT23-3	450	mW
Power Dissipation Die	1	W
Operating Temperature Range	0 to 85	°C
Storage Temperature Range	-55 to 150	°C

Electrical Characteristics

Measured at T_{AMB} = 25°C, L = 4.7µH and V_{CC} = 1.5V unless otherwise specified.

Parameter	Conditions	Limits			Units
		Min	Typ.	Max	
Supply Voltage Operating Range	L = 10µH	0.9		2.2	V
Minimum Supply Start-up Voltage	L = 10µH		0.8	0.9	V
Switch Current	At turn-off	250	320	400	mA
Switch Saturation Voltage	I_{OUT} = 200mA		100	300	mV
Switch Leakage Current	V_{OUT} = 20V	40	70	120	µA
Mean LED Current	V_{LED} = 3.5V	40	55	70	mA
Efficiency	V_{LED} = 3.5V		85		%
Operating Frequency	V_{LED} = 3.5V		350		kHz
Discharge Pulse Width		0.7	1.5	2.5	µs

Device Description

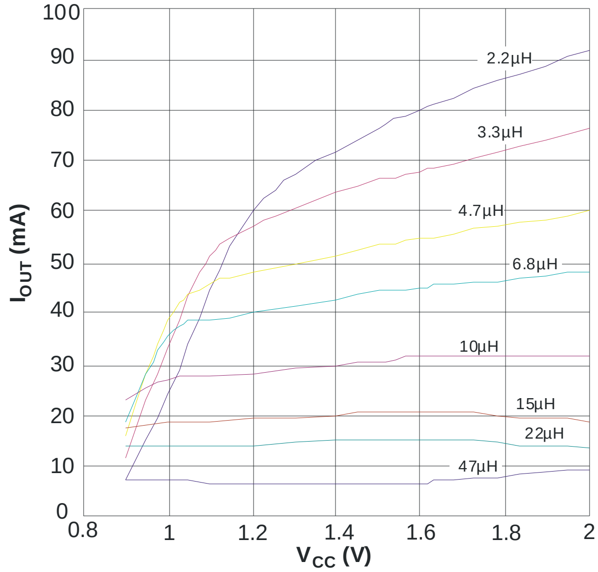
The ZXLD381 is a simple PFM, DC-DC controller combined with a high performance internal switching transistor, enabling the production of a high efficiency boost converter for use in single cell applications. A block diagram is shown for the ZXLD381 in Fig 1.

When power is applied, an oscillator within the pulse control block forces the internal switching transistor to switch on to start an energy charge cycle. The low saturation voltage switch pulls the V_{OUT} pin close to ground which forces the supply voltage across the external inductor L1. This causes a current to build up, storing energy in the inductor. During this phase, switch current and supply voltage are monitored and used by the pulse control circuit to determine the optimum drive conditions and on-time. At the end of the energy charge cycle, the internal switch is turned off rapidly, interrupting the current flow through L1 which causes the voltage on V_{OUT} to rise dramatically. When the voltage on V_{OUT} reaches the load LED's forward (on) voltage, the inductor current is transferred from the internal switch to the LED, starting the energy discharge cycle. With the voltage across the inductor reversed, the current flowing through it (and the LED) now falls. When the inductor current reaches zero, the voltage on the V_{OUT} pin falls back towards V_{CC}. This action is sensed by the pulse control circuit, which initiates the next energy charge cycle. Except for low level losses, all the energy stored in the inductor during a charge cycle will be channeled to the load LED during the following discharge cycle.

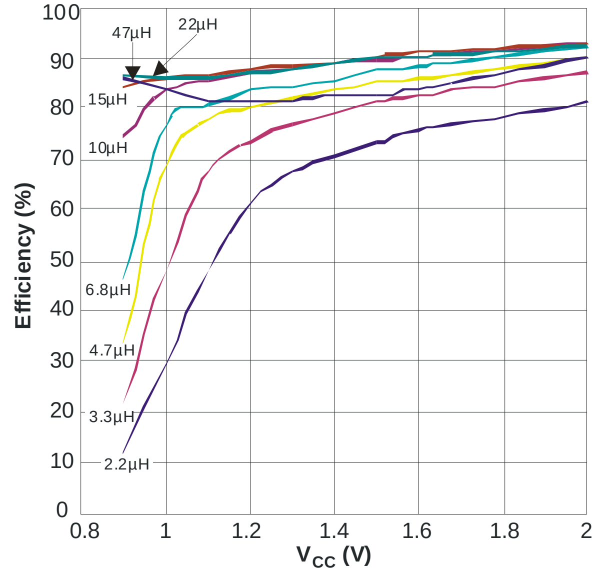
The current fed into the load LED has a sawtooth waveform, the average (DC) value of which is kept constant by the pulse control circuit for varying supply voltage and temperature. It is possible to change the output current given by the ZXLD381 by changing the value of inductor L1. The larger the inductance of L1, the lower the output current. A table/graph showing the relationship between inductance and output current is given later in this datasheet. Since the output current of the ZXLD381 is a sawtooth waveform, its peak value is substantially larger than the DC/average value. The table also provides this data.

The internal switching transistor has a minimum collector-emitter breakdown voltage of 20V and this sets the maximum load voltage allowable. The minimum value is set by a feature of the pulse control circuit that requires the load voltage to be at least 0.8V greater than V_{CC}. (The device will function with load voltages smaller than this but output current regulation will be impaired.) Higher than nominal load voltages will lower the average (DC) output current generated for a given inductor value.

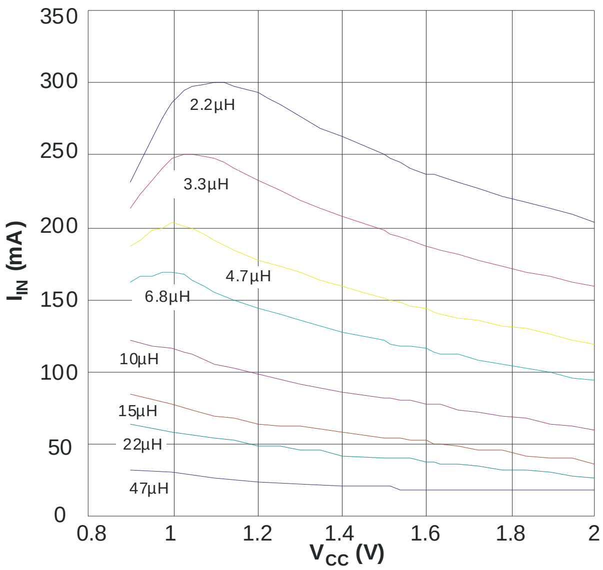
Typical Characteristics



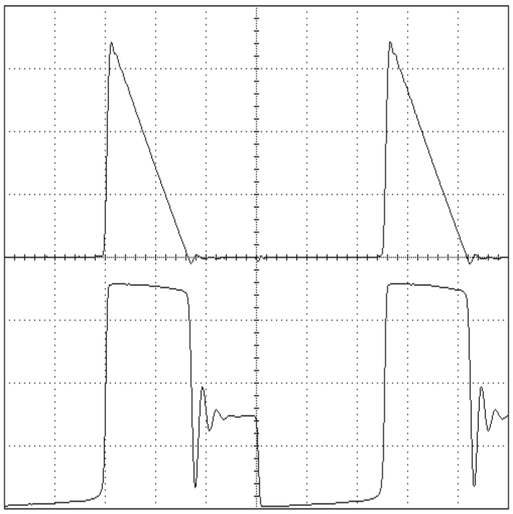
$I_{OUT(AVERAGE)}$ vs. V_{CC} for L = 2.2µH to 47µH



Efficiency vs. V_{CC} for L = 2.2µH to 47µH



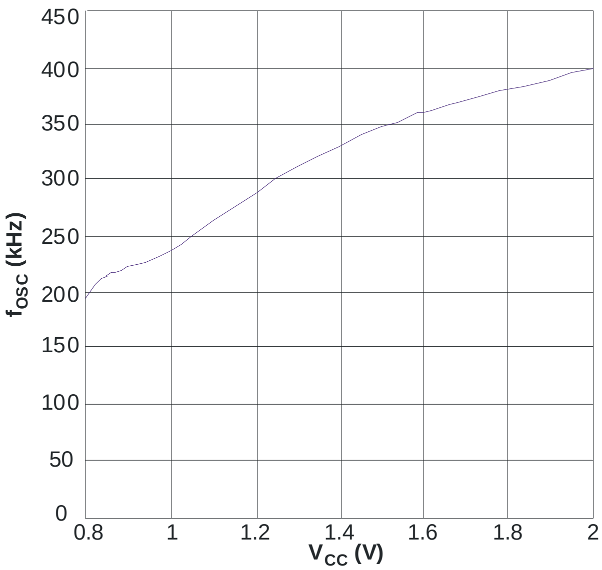
I_{IN} vs. V_{CC} for L = 2.2µH to 47µH



Channel-1 (Upper): I_{LED} @ 100mA/cm
Channel-2 (Lower): V_{OUT} @ 1V/cm
Timebase: 500ns/cm
Operating Waveforms for L = 4.7µH, V_{CC} = 1.5V

Notes: V_{LED} = 3.5V for all graphs

Typical Characteristics (Cont.)

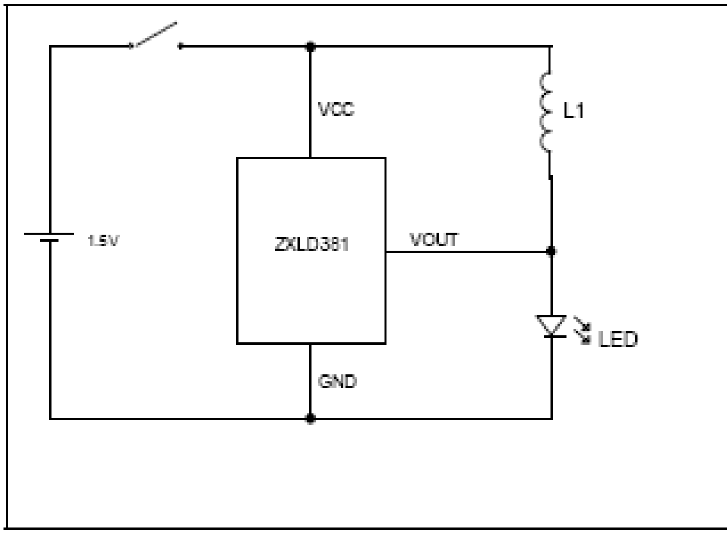


f_{OSC} vs. V_{CC} for L = 47µH

Notes: V_{LED} = 3.5V for all graphs

Application Examples

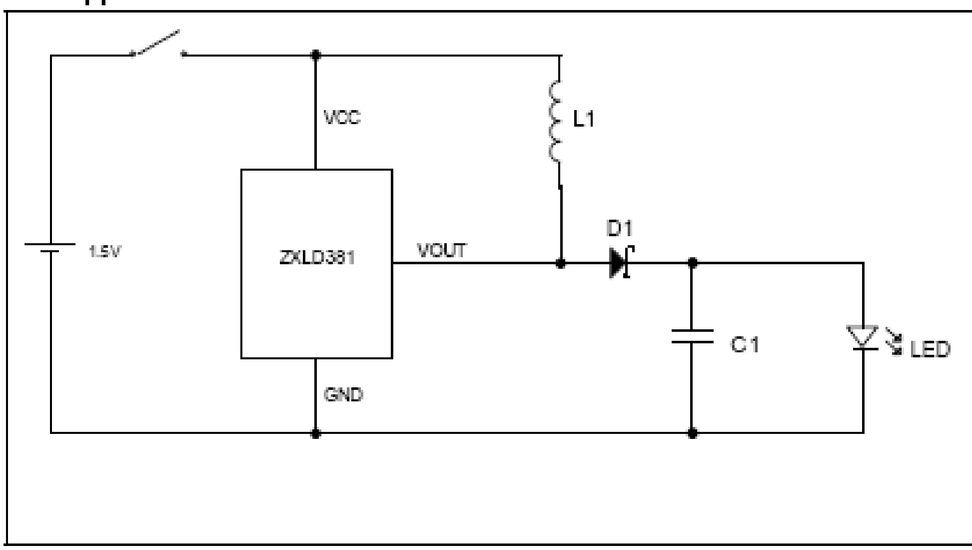
Standard Operating Mode



L	I_{LED}(peak)	I_{LED}(avg)
(uH)	(mA)	(mA)
47	35	6.5
22	80	15
15	120	20
10	190	30
6.8	260	45
4.7	380	55
3.3	510	67
2.2	640	76

Notes: V_{LED} = 3.5V

Low Ripple LED Current Mode



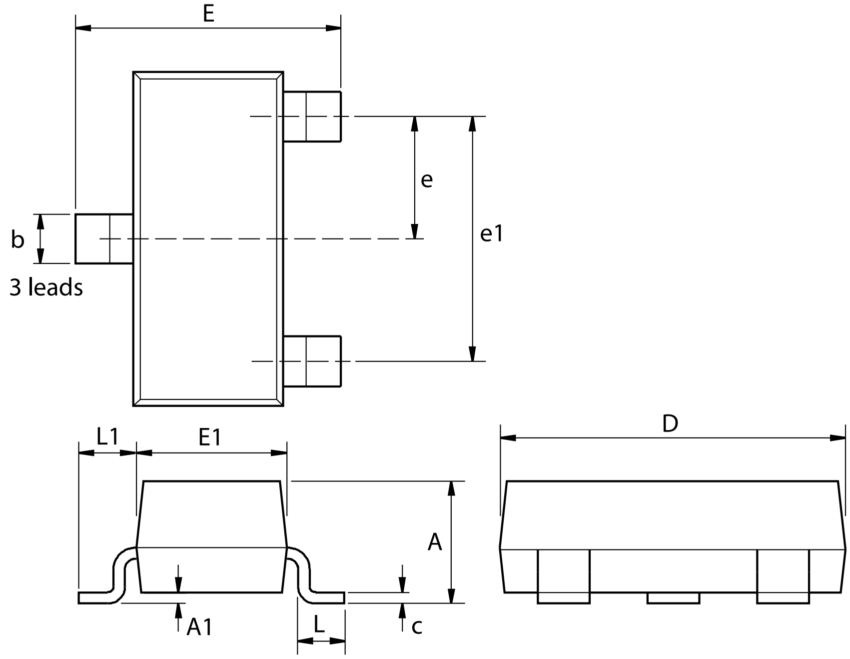
L	I_{LED}
(uH)	(mA)
47	6
22	13.5
15	18
10	27
6.8	41
4.7	50
3.3	61
2.2	69

Notes: V_{LED} = 3.5V, D1 = ZHCS1000, C1 = 1F (low ESR)

Ordering Information

Part Number	Package	Part Mark	Tape Width (mm)	Quantity (per reel)
ZXLD381FHTA	SOT23	381	8	3000

Package Outline Dimensions



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	-	1.12	-	0.044	e1	1.90 NOM		0.075 NOM	
A1	0.01	0.10	0.0004	0.004	E	2.10	2.64	0.083	0.104
b	0.30	0.50	0.012	0.020	E1	1.20	1.40	0.047	0.055
c	0.085	0.20	0.003	0.008	L	0.25	0.60	0.0098	0.0236
D	2.80	3.04	0.110	0.120	L1	0.45	0.62	0.018	0.024
e	0.95 NOM		0.037 NOM		-	-	-	-	-